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ABSTRACT

The international TEMPUS (Trans-European Co-operating and Mobility Scheme for Higher Education between Central/Eastern Europe and European Union) project lasted from 1995-1997. In the framework of TEMPUS, a material and knowledge background was developed in order to ensure the education of the branch Geological Engineering with specialization in Environmental Hydrogeology at VSB-Technical University Ostrava. Several other co-operating European universities (e.g. University of Granada, Ludwig-Maximilians Munich, University of Provance in Marseille, University Aix Marseille III, University Franch-Comte Besancon) and institute TNO Delft were involved in the project. To ensure a high level of quality in teaching material equipment, including new scientific literature, was purchased (laboratory and computer equipment including software) and teachers were systematically retrained at the co-operating universities. The education is based on a credit system newly established at the Faculty of Mining and Geology of the VSB-Technical University Ostrava. This system enables flexible profiling of graduates to meet the present demands of hydrogeological exploration, groundwater protection, and general environmental protection. (Author/YDS)

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Example of International Co-operation in the frame of the Project Phare (TEMPUS) in Innovations in Teaching of Environmental Hydrogeology in Engineering Education in the Czech Republic

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Abstract:

In the framework of the international TEMPUS project (1995 -1997) the material and knowledge background was developed in order to ensure the education of the branch Geological Engineering with specialization in the Environmental Hydrogeology at VSB – Technical University Ostrava.

Several other co-operating European universities (e.g. University of Granada, Ludwig-Maximilians Munich, University of Provance in Marseille, University Aix Marseille III, University Franch-Comte Besancon) and institute TNO Delft were involved in the project.

To ensure high level of quality in teaching of the above given specialization material equipment including new scientific literature was purchased (laboratory and computer equipment including software) and teachers were systematically retrained at the co-operating universities.

The education is based on credit system newly established at the Faculty of Mining and Geology of the VSB – Technical University Ostrava. This system enables flexible profiling of graduates to meet the present demands of hydrogeological exploration, groundwater protection and generally environmental protection.

Introduction

Political changes after 1989 in the Czech Republic opened possibilities for Czech universities to establish direct co-operation in science and education with universities and institutes all over the world. This fact was, of course, limited economically. Nevertheless grants were awarded to Czech universities in the frame of Phare budget for assistance to the countries of Central and Eastern Europe. The following figures 1 to 3 show the development of co-operative network of the VSB –Technical University in the field of Hydrogeological and environmental sciences.

In the year 1994 the Structural Joint European project entitled "Groundwater and Soil Protection as Integral Part of Environmental Protection in the Industrial Areas" was submitted by VSB –Technical University (the Institute of Geological Engineering) in the frame of TEMPUS Programme (Trans-European Co-operation and Mobility Scheme for Higher Education between Central/Eastern Europe and European Union). This project proposal was awarded a grant from the European Union's overall PHARE budget with the contract N° JEP 8300.

Fig. 1 Co-operative network of the VSB -Technical University in the field of Hydrogeo-logical and Environmental sciences (before year 1989)

Project TEMPUS JEP 8300 objective

In our original application we supposed to meet the following objectives:

- to improve the university teaching capacity of Czech partners in the specialisation Environmental Hydrogeology with special aim at groundwater and soil protection,
- to create new curriculum of the above-mentioned specialisation, modernisation of practical training in groundwater and soil protection, assessment and remediation methods with new computational , audio-visual and field techniques,
- to build-up documentation centre, library, laboratory for teachers' training at both Czech partner universities,
- to establish direct co-operation among universities,
- to stimulate Czech industry and possibly establish a consulting group within the topics of this JEP.

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In project contract the objective "to create new curricula in the Environmental Hydrogeology" was accented as a main objective of the JEP. The project was planned for three years duration.

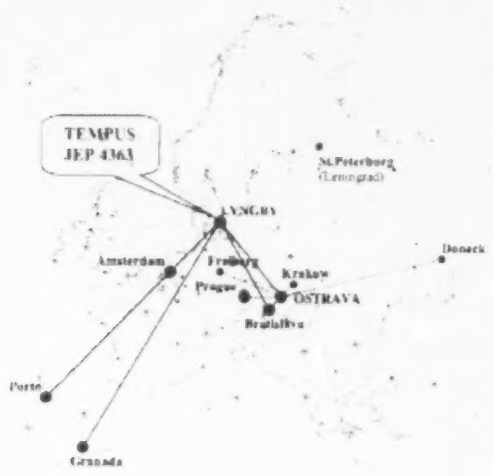

Fig. 2 Co-operative network of the VSB -Technical University in the field of Hydrogeological and environmental sciences

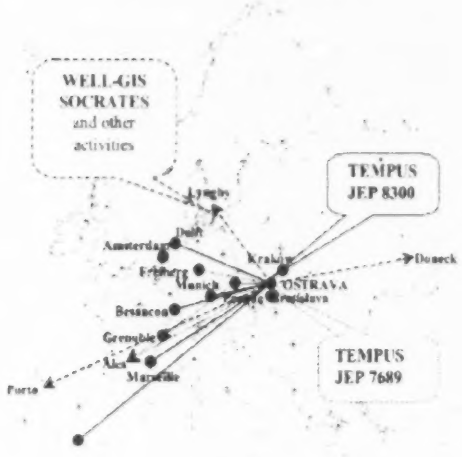

Fig. 3 Co-operative network of the VSB -Technical University in the field of Hydrogeological and environmental sciences, GIS TEMPUS JEP 8300, 7689 - 1994-1997)

Coordination structure

Project coordination structure described the pattern given in the project proposal. The project was managed by the main coordinating centre at VSB - Technical University Ostrava, that communicated with ETF Tempus Department and administered global funds. Partners in the TEMPUS project JEP 8300 were as follows :

Czech Republic : Charles University Prague
France : University of Provence Marseille (Aix-Marseille I)
University Aix Marseille III
Universite de Franche-Comte, Besancon
Spain: University of Granada, Granada
Germany: Ludwig-Maximilians-Universität Munich
The Netherlands: Institute of Geoscience TNO , Delft

The coordinator was in charge of the program, reviewed the results and took the necessary decisions. Representatives (contact persons) of the organisations involved took the actions according to the project and were responsible for scientific planning and content of activities. All budget questions belonged to coordinator responsibility.

The decision-making process was applied through the planning meetings of the responsible representatives from the participated universities. Individual problems were collectively discussed and mutual agreement was sought. All agreements taken in the meetings were considered as obligatory. Further action was taken and administered on a local level, where contact persons had full decision-making power.

Project outcomes

In order to achieve the objective of JEP 8300 to create new curricula in the Environmental Hydrogeology - Soil and Groundwater Protection eight outcomes were defined:

Ref N°:	Title of outcome	Universities concerned by outcome
1	Staff retraining in the fields related to Environmental Hydrogeology	VŠB-Technical University Ostrava, Charles University Prague
2	Student exchange scheme	
3	Development of teaching materials	
4	Development of new courses	
5		
6	Improvement of technical equipment of Training centres and scientific libraries	
7	Improvement of technical equipment of Laboratories for Numerical Modelling	
8	New curriculum of Environmental Hydrogeology	

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These individual outcomes on the whole complex create material and intellectual conditions under which the project objective has been achieved and will be further developed.

Description of activities carried out

Activity - short courses

Six short intensive courses were organised during three academic years. The short courses enable the retraining of broader group of teachers and graduate students in disciplines aimed at groundwater and soil protection in industrially damaged areas. The participants have been acquainted with modern field, laboratory, computational and analytical methods. Some teachers and students could go deeper into a selected subject during study stays, short visits to the EU universities. The staff was educated in using modern field, laboratory and computational equipment which can be purchased within the framework of the project.

Activity - Student Mobility

During TEMPUS project a number of students´ study stays was realised at the partner universities. These stays were appreciated very much and the participants were satisfied with the possibility given to them to take direct part in research projects in EU countries. The students realised very well the importance of such stays, professional contacts and foreign language knowledge. The stays have usually strongly influenced the professional background and the future professional direction of participants. The positive influence on the students´ professional abilities and technical development is evident. The didactical approaches at partner universities have been also taken into account when modifying the new curricula.

Knowledge of national languages was recognised as a major problem of student study stays. The lectures are held in national languages at all partner universities. The most of our students studied English before the beginning of their study stay. Their command of national languages was bad or none. They attended the lectures given in subjects of their interest, although they could not fully understand and were not able to pass the exam. On the other hand, most of them appreciated the possibility of learning individual national languages and now they are doing their best to continue learning these languages. From the above-mentioned reasons graduate students got preferences in the selection because they are able to carry out independent research supervised by professors from partner universities.

As students were not involved in regular courses and they did not pass any exams, the academic recognition of undergraduate students was not possible. Students returning from study stays abroad had to catch up with all deficiencies at their home universities. They will benefit from the study stay results in their diploma thesis. In case of postgraduate students the study stays were recognised as an integral part of their postgraduate study, and study stays have strongly influenced the scientific level of their PhD. thesis.

We highly appreciate that students have become acquainted with the latest knowledge in the subjects in which EU universities have reached a very sophisticated level, owing to availability of computers, routine software and advanced physical and chemical instruments. The study stays has strongly influenced the professional background and possibly the future professional career of the students, too.

Activity – Short visits of staff at EU universities

To achieve project outcomes – curriculum development, courses and teaching materials development – the teachers visited partner universities (usually for one to two weeks) where they collect teaching materials, utilised access to libraries and discussed problems and educational experience with partners. Impact of project realisation can be seen in adjusting the level of university teachers and staff in the subjects, which are not developed in Czech Republic in such extent like in EU countries. New methodology was brought to the process of education at Czech universities.

Activity - Field training

Three field training courses of one week duration were organised in the frame of the project. The interest to participate in them was very high from the side of EU partners and their impact was highly evaluated. The field training had the following objectives:

- to improve knowledge in the field of Environmental damage, ground water and soil protection.
- to educate teachers to an international level of knowledge and pedagogical capability.
- to establish direct co-operation among the universities involved, including bringing teachers and students from the Czech Republic, and EU countries together.

Activity - Practical placement of EU students in the Czech Republic

The prevailing direction of mobilities in Tempus project was, of course, CZ→EU. The possibility of practical placement in Czech companies was, on the basis of good previous experience, fully realised.

Three practical placements were carried out in the third year of the project (totally 8 months). The increased interest in practical placement in the Czech Republic became apparent especially at universities which students took part in this activity in the past (Granada, Marseille). We

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understand this fact as an assessment of good organisation of this activity. Perception of students in the companies was very good. The students performed several kinds of activities in several companies. Each one was close to environmental protection and consisted of an aspect of an environmental survey. The students evaluated the stay as really enriching, helping them to perceive environmental problems of the Czech Republic and especially how they can be solved in practice.

Activity – Purchase of equipment

During the whole three years duration of the project, the TEMPUS funding resulted in decisive support for purchasing the equipment for both laboratory and field training and courses.

The purchasing of the equipment has been decisive for the final goal of the Project. It has enabled to enhance the whole didactic process and to get it to a higher level. Without the new equipment a progress in the necessary restructuring of the curricula and the laboratory and field training would be considerably smaller. The equipment of training centres has resulted in more intensive and independent work of both undergraduate and graduate students. The students are the principal users of all training centres.

During the whole JEP 8300 the following training centres and laboratories at both beneficiary universities have been established:

- Teaching Laboratory for GIS, Remote Sensing,
- Laboratory of Numerical Modelling,
- Training Centre and Sc ientific Library.

Tempus project did not provide money for maintenance procedures and insurance arrangements. This is the responsibility of departments, which received the equipment, and costs will be covered from university budget. The other financial sources than Tempus budget were used for development of the above-mentioned laboratories and training centres as well. The choice of equipment was in responsibility of both beneficiary universities. The decision-making process was based on development plans of the departments involved .

Description of outcomes of the TEMPUS JEP 8300 project

As all achieved outcomes are coherent and each of them play an important role in the achievement of the final objective of the project - development of curriculum of the Environmental Hydrogeology - it is difficult to point out some of them as a key success. Nevertheless, we especially appreciate the following outcomes and activities :

- staff retraining and student exchange, 6 short intensive courses were organised during the project with totally 139 participants (99 mobilities in total duration 155,6 weeks), furthermore 29 teachers were educated within totally 43.5 weeks of mobilities CZ→EU (short visits and staff retraining). 28 mobilities EU→CZ for teachers were organised in total duration of 25 weeks. Student exchange scheme was established. 13 students spent totally 103 months of study stays at partner universities. All project partner institutions were involved in the project activities.
- development of new courses and teaching materials, directed to modern environmental aspects of hydrogeology, engineering geology and applied geophysics which in fact have led to a fundamental changes in the concept of curricula. Tables 1 to 3 summarise achievements including target group (important multiplier effect).
- development of new curricula and revision of recognised curricula,
- establishment of teaching laboratories, library create very good material conditions for teaching activities at the level comparable to European standard.

Curriculum Development

During the project performance the important changes have been realised in the curricula development.

The necessities of both Czech partners of the project were different, due to difference in background (technical faculty × natural sciences). The restructuring of education at the Faculty of Mining and Geology of the VSB - Technical University Ostrava has to be done due to suppress of mining industry in the Czech Republic and new branches dealing with different aspects of environmental protection are being established. Environmental Hydrogeology as a new specialisation should be introduced in addition to already existing Hydrogeological and Engineering Geological Exploration. Due to Tempus project activities branch Environmental Engineering was revised as well. At present important changes in study system at faculty occur, the credit system is introduced what is connected with introduction of new courses to the present curricula.
The prepared proposal of the curriculum of Environmental Hydrogeology is now under the process of evaluation and accreditation at the VSB – Technical University Ostrava. Nearly all activities, planned in order to achieve the individual outcomes, were used for curriculum development.

In the same time the PhD studies started to be more interdisciplinary within the framework of the Institute. Students also participated at activities given in English during the TEMPUS Project, as short courses and field

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training. During the study stays at foreign universities, in addition to English the students have got familiar also with other languages as German, French and Spanish. This everything can be considered an important step for continuous change and modification of the Czech graduate (PhD) studies to approach them more closely to the level achieved by PhD students at West-European universities.

Development of new courses

Upgrading of individual already taught courses and introducing entirely new courses (tables 1, 2 ,3 - next page) is a long-term process connected with introducing new curricula. All achieved outcomes result in an increased teaching quality on the level of knowledge comparable to European standard.

Development of teaching materials

In general, three large groups of didactic material have been purchased or developed during the TEMPUS Project:

- The support given by the TEMPUS project has enabled to purchase books, proceedings of conferences and congresses and other latest foreign publications dealing with the topics of applied and environmental geology, esp. in English and in French. These publications have been incorporated into the geological libraries of both Czech universities and are available to the staff and students and the professionals interested in the topic.
- The materials of the second group have been developed during the TEMPUS Project by the partners participating within the project. Mainly text-books for the TEMPUS short courses and for field training belong to these materials. They were developed usually by the organisers of the respective TEMPUS activity but often together with other participating organisations. Regarding the language, almost all the materials were prepared in English.
- New teaching materials for individual revised and new courses processed at Czech universities represent the third group. Materials are partly adapted and translated, partly are used in original (especially those written in English).

The support given by Tempus project in this field is of high importance, as teaching materials obtained from abroad have considerably helped in improving of teaching process. The usefulness of teaching materials is very high as access of students to modern scientific literature via university library is still limited.

Impacts of the project

The achievements of the project JEP 8300 fully support both main objectives of the Tempus scheme. All Tempus activities (staff retraining, short intensive courses, student mobilities, purchase of equipment) considerably influenced the quality of education in already recognised curricula. Furthermore new curricula and several new courses in recognised curricula were introduced. Purchases of equipment (hardware, laboratory equipment, software, literature) improved the access to scientific information. All the above-given achievements result in the increased quality of higher education in geological and environmental sciences at both Czech universities. Very well operating partner institution network, mutual knowledge of educational and research activities create good basis for future co-operation

With regard to discussions held at board planning meetings it can be stated that EU partner institutions felt positive impact of Tempus project although they could not use some advantages as beneficiary institutions. They appreciated very good functioning of project network, newly established personal contacts and mutual knowledge of scientific activities and didactical approaches. The Tempus project established good basis for further co-operation of partners in education and science in the frame of ERASMUS, Copernicus, Barrande (French – Czech) etc. The exchange of experience in education and exchange of students was mutually contributive.

Dissemination of project results

Several forms of project results spreading beyond the immediate target group were identified:

- Availability of literature, teaching materials, software and equipment at training centres and scientific libraries and laboratories built as a result of the project,
- Regular courses (new and revised) open for colleagues from other departments,
- Open public courses organised in the frame of Tempus project for enterprises and local administration,
- Consultancy given to enterprises and local administration.

The multiplier effect of the project becomes evident especially in connection with staff retraining to the level of EU teachers. Introduction of new curricula, revised and new courses transfers the benefit of the project beyond immediate target group.

Dissemination of project results out of involved universities was planned as one of the outcomes. During the last two years of the project performance 4 open public courses were organised (totally 75 participants from companies and local administration) in order to fulfil one of the project objective – to stimulate Czech industry.

Stimulation of co-operation with industry

Contacts with different consulting and industrial organisations and companies have been realised especially in the connection with three following TEMPUS activities:

- During the field training, professionals from different organisations participated in guiding at particular sites in the field and co-operated also in the preparation of guides for field training,
- Another links university - industry have been developed in connection with short courses organisation. This co-operation has had a two way character: on one side the specialists in different branches of hydrogeology, chemistry, technology, water quality, numerical modelling etc. from different companies delivered lectures at the courses, on the other employees (esp. younger ones) from different enterprises attended the courses in the Czech Republic,
- In different external organisations the field training and practical placement of students from the EU countries were realised as well.

The response of enterprises was with no doubt positive. Enterprises are more ready and active in involvement of students in practise in the forms of practical placements, co-operation on their master and doctoral thesis. They are interested in the various forms of continuing education. They are also willing to deliver the lectures on the special topics from practise at universities. We appreciate improved mutual co-operation with enterprises and local administration. These contacts with specialists from different companies and administrators and decision makers have indicated us the most important present environmental problems and as the feedback have helped us to revise the curricula.

Table 1: Revised courses

Subject / University	Target public / students reached directly each year	Year of study	teaching hours per week / number of weeks	compulsory / optional	official recognition
Groundwater and Soil Protection / VSB Ostrava CZ	undergraduate / 10 graduate / 3	5	4 / 15	compulsory/ optional	fully supported
Geotechnical Aspects of Waste Disposals / VSB Ostrava CZ	undergraduate / 12 graduate / 2	5	2 / 15	compulsory/ optional	
Soil Protection / VSB Ostrava, CZ	undergraduate / 25 graduate / 2	4	4 / 15	compulsory/ optional	
Hydrochemistry and Water Sampling / VSB Ostrava,CZ	undergraduate / 8 graduate / 1	3	4 / 15	optional/ optional	
Environmental Monitoring / VSB Ostrava CZ	undergraduate / 23 postgraduate / 3	5	3 / 15	compulsory/ optional	
Pedology / VSB Ostrava,CZ	undergraduate / 25 postgraduate / 2	3	4 / 15	compulsory/ optional	
Hydrogeology / VSBOstrava, CZ	undergraduate / 8 graduate / 2	4	6 / 15	compulsory/ optional	
Methods of Hydrogeological Exploration / VSB Ostrava, CZ	undergraduate / 8 graduate / 2	5	4 / 15	compulsory/ optional	

Table 2: New courses within existing curricula (restructuring of curricula)

Subject / University	Target public / students reached directly each year	Year of study	teaching hours per week / number of weeks	compulsory/ optional	official recognition
Monitoring Systems in Hydrogeol. and Engin. Geol.	undergraduate / 3 graduate / 2	5	2 / 15	optional optional	fully supported
HydroGIS / VSB Ostrava, CZ	undergraduate / 3 graduate / 2	5	2 / 15	optional/ optional	
Groundwater Tapping and Dewatering / VSB Ostrava,	undergraduate / 4 graduate / 2	5	6 / 15	compulsory/ optional	

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Table 3: New courses developed for new curriculum Environmental Hydrogeology

Subject / University	Target public	Year of study	teaching hours per week / number of weeks	compulsory/ optional	official recognition
Geophysics in Applied Geology / VSB Ostrava, CZ	undergraduate graduate	5	4 / 15	optional optional	So far no recognition
Using of Remote Sensing for Evaluation of Environ. Damage	undergraduate graduate	5	2 / 15	optional/ optional	
Design and Construction of Waste Disposals / 1, CZ	undergraduate graduate	5	4 / 15	optional optional	
Applied Geochemistry / VSB Ostrava, CZ	undergraduate graduate	4	4 / 15	compulsory optional	
Modelling of Groundwater Flow and Contaminant Transport	undergraduate graduate	5	4 / 15	optional optional	

Functioning of the project network and future co-operation

We evaluate the functioning of network very well. In comparison with the beginning of project we felt considerable improvement. This fact can be easily understood because contact persons at partner institutions were by the time acquainted with the scheme of planned Tempus activities and the rules of contract as well. Furthermore due to personal contacts of staff of involved universities mutual knowledge about the background and sphere of interest of individual partners is good. The success of some activities already carried out called up for an increased interest in involvement in the project activities and partners came with suggestions of other activities, which had not been planned in the project. Their willingness to organise the planned activities was high. We really appreciate their work, sometimes may be not evaluated enough at their own universities.

According to our opinion beneficiary institutions will be able to carry and develop the achievements of the project. The limitations are given by difficult economic situation of the Czech Republic which does not allow the support of education necessary for real development of education and research at EU standard level. Further development depends on the state support of Higher education from the budget funds and on the support gained by national investigation projects (grants) and international projects in the frame of Erasmus, Copernicus, Barrande etc. Various activities are performed to ensure financial resources for education and research.

The contacts among partner universities, as started and maintained by the TEMPUS project have created adequate basis for future co-operation. It is to be expected especially in the following directions :

- joint field training of undergraduate and graduate students,
- organisation of short courses on environmental issues within the future projects as e.g. Erasmus,
- future exchange and/or co-operation of students at different levels, esp. at master and PhD level, could be realised.

Conclusion

We can summarise that the TEMPUS Project has represented an important turning point in our educational work. The main project objectives, i.e. restructuring the curricula of courses by means of new courses, modernised educational tools (computers, software, laboratories, audio-visual facilities) and available teaching materials (new manuals, methodological guides for practical training and upgraded library) has been reached.

This helped us to incorporate our undergraduate and graduate students more closely and effectively into scientific programs and have resulted, in our opinion, in better educational process and greater activity of students.

We also expect the initiated co-operation between the partner organisations will be maintained and strengthened in the respective educational and scientific fields in the future.